

# Hot Iron

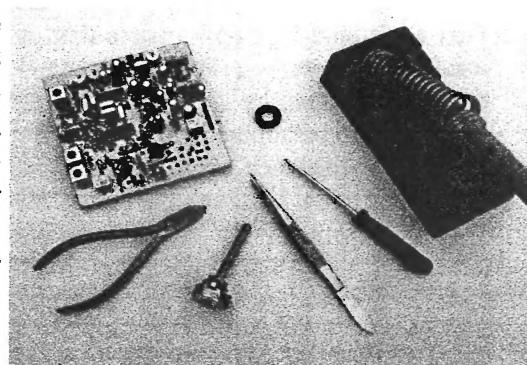
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## Editorial

Recently, at the Yeovil ARC, we had a talk by Steve Hartly (Newcomers columnist in Radcom) about the forthcoming licence changes. Next year, all people wishing to become radio amateurs will have to first take the new Foundation Licence, then the Intermediate and finally the Full licence if they wish to be able to use all the facilities available to radio amateurs. It will be possible to stop at any stage through this process. The scope of the courses is much wider than the old C and G RAE, there is a strong element on operating practices, with a good piece of circuit construction being regarded as essential. These changes can only be good for the hobby as is already shown by the number of new licences issued. Already a few thousand new licences have been issued compared to just a few hundred of the older Novice ones. There is now a strong new flow of blood into the hobby. The old chestnut of CW is being addressed; for the present the Government has to still require it due to International Law but it is likely to be dropped soon. Plenty of people will still use it though – especially for QRP since it allows simple gear to be made. Good news all round!



## Kit Developments

The **Fivehead** transceiver is now available after testing by members Geary and Howgate. To remind you, it is an any single band phone superhet producing nominally 1.5 Watts (on 13.8 volts) for any band 20 - 160m. It is small (open upright format with 100x100 main PCB) and pretty dense for /P operation. Many optional extras but the 10 Watt Linear is likely to be often paired with it. Prices are £79 for the Fivehead and £23 for the Linear.

I have also completed the layout of a new **QRP Antenna Matching Unit**. The latest version is a T match with resistive matching bridge and LED indicator. For all bands 10 to 160m, and all likely balanced or unbalanced loads. Small open upright format (100x100 base PCB). Normally £29 but £27 for Con-Club members - available in about two weeks when the text is completed!

The next project is the **Triton**! A 1.5 W direct conversion CW TCVR for 20, 40 and 80m. This will use a ceramic resonator VFO and should be pretty small! Some work still needed!

By mistake I have just bought a second copy of a book that I already have, Radio Frequency Transistors by Helge & Granberg—anyone interested? And finally, since it is just December as I write this, **A VERY HAPPY CHRISTMAS** to you all, Tim Walford G3PCJ.

**Hot Iron** is a quarterly subscription newsletter for members of the Construction Club. Membership costs £6 per year with the first issue for each year appearing in September. Those people joining later in the year will be sent the earlier issues for that year. Membership is open to all and articles or questions or comments or notes about any aspect of electronics—principally on amateur radio related topics— is very welcome. Notes on member's experience building their own gear, from kits or otherwise is most interesting to other constructors. To keep it interesting, your thoughts and ideas are required please! For membership, I only need your name and address and subscription. Send it or any other suggestions to Tim Walford, Walford Electronics, Upton Bridge Farm, Long Sutton, Langport, Somerset TA10 9NJ © G3PCJ

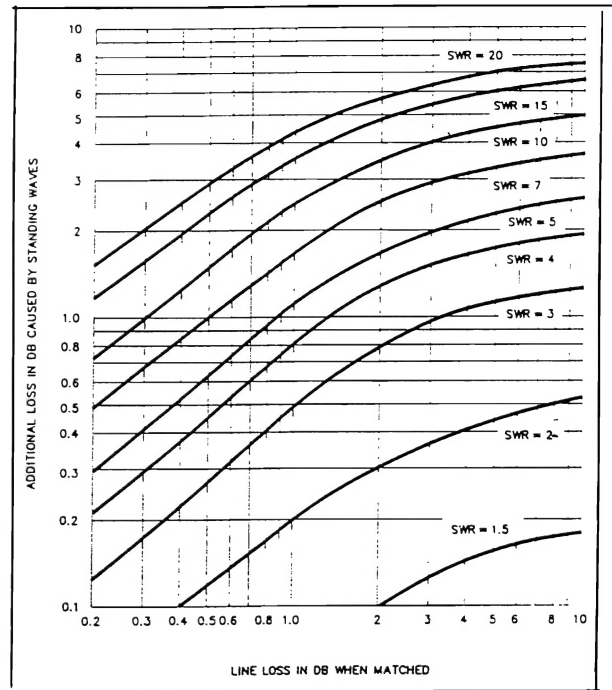
## **SWR and Effective Feeder Losses** by Eric Godfrey G3GC

Most amateurs know that the effective loss in a feeder connecting a transmitter to an aerial is increased when the SWR is more than 1:1 and that this effect increases with an increasing SWR and higher initial feeder losses. Since the loss in a feeder always increases with frequency this is more likely to be a problem at VHF and above. These frequencies do not normally concern "Hot Iron" which generally leans towards HF matters. However a short note on this might be of interest to readers, many of whom no doubt operate on VHF and at the same time perhaps put the skeletons of a few misconceptions to rest.

The graph on the right shows how much additional feeder loss has to be added for various values of SWR and initial feeder loss. You will see that even with an SWR of 2:1 and an initial feeder loss of 1 dB, which is quite high with only 79% of the transmitter power reaching the aerial, that the amount to be added is only 0.2 dB making a total of 1.2 dB. This additional loss now means that only 76% of the power reaches the aerial. This additional loss only reduces the transmitted power by a further 3%. Such a small difference is unlikely to be apparent at the receiving end. If the feeder is a coaxial feeder then one of a larger diameter would not only reduce the initial loss but also reduce the amount to be added.

The loss in any coaxial feeder, which will have an inherently a low impedance of around 50 to 75 Ohms, is made up of "copper" losses and "insulation" losses. In a coaxial feeder the copper losses can be kept to a minimum by using as large a diameter feeder as is possible. The best insulator to use is either dry air or nitrogen. However these are impractical since some rigid support is required to hold the inner central with the outer. This forms the insulation and the losses are kept as low as possible by using as little of the highest quality insulator as possible. Most coaxial feeders used by amateurs have solid polythene insulation although for UHF some amateurs do use feeders where the support of the inner is from a continuous helical polythene membrane. However this type of feeder has the disadvantage that one has to ensure that the air inside is absolutely dry or the losses will be higher than the specification and under certain circumstances, could be worse than solid polythene. Some amateur HF installations use pair line open wire feeders particularly to feed multi-band aerials. These are inherently high impedance feeders usually between 200 and 600 Ohms. The copper losses now are from the two wires and the insulation losses from the method used to hold the two wires apart. Commercial feeders use a continuous length of thin polythene between the wires to hold them in place about centimetre apart. Some have slots or windows cut into the polythene to reduce the amount of insulation and thus reduce the loss. However it is not unusual for these high impedance feeders to be home brew with 16 SWG or thicker copper wire spaced about six inches apart with spreaders every 2 feet or so. This type of feeder will usually be around 600 Ohms whereas the commercial polythene insulated feeder will be around 300 Ohms. The spacers for the home brew feeders were made in the past from either wooden dowels that had been impregnated in either molten paraffin wax or polyurethane varnish. Today it is possible to make them from plastic which can be obtained from DIY stores in either circular or rectangular sections. Plastic knitting needles have also been used by some amateurs. However whatever plastic is used it should be checked to see that it is not lossy by putting it in a microwave oven for a few moments. If it gets warm or melts it is lossy and should not be used. Since there is very little insulation associated with these feeders then provided the spreaders are kept in good condition, they have a very low loss. The wires are responsible for the copper losses and these will be kept to a minimum making the wire as large a gauge as possible. Wires of 16 or 14 SWG are commonly used. High impedance open wire feeders are commonly used to feed multi-band HF aerials where the impedance at the aerial terminals can be either low around 50 Ohms or high around 1,000 to 2,000 Ohms depending on the band in use. Since any of these impedances will automatically give a high SWR on the feeder, the high impedance low feeder loss will be beneficial.

Perhaps a few words about impedance matching units (commonly but incorrectly called Aerial Tuning Units or ATUs) will not be out of place here. An "ATU" in the shack connected to the input of the feeders feeding the aerial will never make any difference to the SWR on the feeders between the "ATU" and the aerial even though the "ATU" has been adjusted to give an SWR of 1:1. The only way to adjust the aerial to the correct impedance is by cutting it to resonance when the value of the reactive component will be zero. However the resistive component may still not be the same as the feeder impedance in which case there will still be an SWR even though reduced. The only solution left is to transform the aerial impedance to match to the feeder impedance using some form of matching network at the **aerial terminals**. Once again nothing can be done at the input to the feeders to reduce the SWR on the feeder.



## **Rig Updates**

### **Bristol TCVR**

Last time I mentioned the particular aspect of the Taunton and Bristol's 20m LO scheme. My suggestion of damping down the amplitude of the 4 MHz crystal oscillator didn't actually work very well! After extensive tests I eventually found that M3BGA's rig was not behaving properly due to a mixed up 1K and 10K resistor in the LO BPF buffer driver. This cured his rig but there is another solution - just change the crystal frequency to 12.5 MHz so that the LO mixer subtracts on 20m - this makes the band tune backwards like 12, 80 and 160m. Nothing else should need changing. I hope this won't be necessary for future designs but it is an option! Janos Ladvanszky (see below) has also examined this. He found that adding LF rejection to the LO BPF driver helped to prevent interaction between VFO and crystal when their frequencies were almost the same.

### **Some mods of the Bristol** by Janos Ladvánszky HA7XN

Greetings to the readers of Hot Iron. I am a Hungarian radio amateur, licensed since 1970. Some months ago I studied the webpages about QRP transceivers and I found a very good report about the Bristol at [www.eham.net](http://www.eham.net). Soon I decided to buy the kit, with all options and four two-band cards. Presently my Bristol is almost ready, only the last half of the S-meter kit has not been built yet. My impression is very good, especially if the system concept is concerned. Also, construction of Bristol offers a wide room for experimenting that I fully exploited. Below I would like to describe some modifications that may be interesting for other builders.

At first two facts are summarized that led to the mentioned modifications. When the LO resonators were tuned in the original setup, I saw that the effects of the two resonators on the filter characteristic are different: The resonator nearer to the LO buffer showed only a little effect. When the frequency meter was built, I measured 170mVpp sensitivity for channel A, and the corresponding output voltage from the receiver was only 50mVpp at the band edges. A trivial solution is a small amplifier inserted at the input of the freqmeter. But another placement of the amplifier is also possible: The LO buffer could be replaced by this amplifier and this way some improvement of the receiver performance was expected.

First I removed the LO buffer FET and its source resistance. I built the amplifier shown alongside. This is a common emitter stage with voltage gain of  $4.7k/680$ , that is, about 7. This gain offers a freqmeter sensitivity of about 25mVpp, far enough in this case. Coupling capacitor at the collector is included in the original circuit. The amplifier is realized on a 5x15mm pcb attached to the main panel near the placement of the former buffer. Introduction of the amplifier has the following advantages:

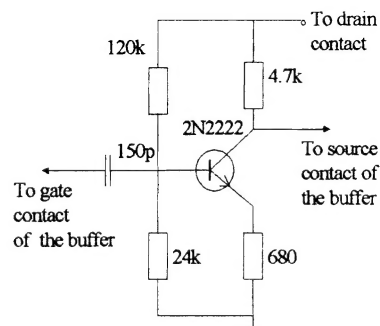
1. Freqmeter sensitivity problem is solved.
2. Receiver sensitivity is increased.
3. Large signal properties of the receiver are improved.
4. Q of the second LO resonator is greatly improved.
5. It is easier to obtain 5W output on any bands.

There is a disadvantage! Some spurious signals occurred at the low end of the 14 MHz band. I eliminated this by changing the input of the LO mixer IC (IC 104, pin 2), it was grounded by a 33p capacitor, forming a 3.3p/33p capacitive divider. As far as the advantages are concerned, point 4 may need some explanation: The output impedance of the amplifier is higher than that of the buffer so does not load the tapped resonator.

A hint: When I started experimenting with Bristol, first I used an energy saving bulb in my lamp. It turned out that this bulb produces a 20kHz signal with very rich harmonic content that can be detected in the lower bands (up to 7 MHz). So please take care if you use energy saving bulb.

Finally I wish similar success to those who perform the same modifications. Please feel free to contact me at [Ladvan@axelero.hu](mailto:Ladvan@axelero.hu) if you wish.

Janos also provided details of his display LED arrangement but I will leave that to the next issue. G3PCJ



## Cdr Bayntum Hippisley

I mentioned last time that Dave Buddery G3OEP, had noted the existence of a First World War listening station in East Anglia with Somerset connections! Based on information from Dave and other sources, it appears that Hippisley, whose family had lived at Ston Easton House near Shepton Mallet since the dissolution of the Monasteries, was the very early radio amateur HLX before the First World War. He had been apprenticed with Thorn Engineering and was later in the North Somerset Yeomanry and later still became G2CW. He was a Justice of the Peace and was High Sheriff of Somerset in 1907, eventually being made a Commander in the Royal Naval Reserve with an OBE and later a CBE for his distinguished career, mainly in intelligence matters. The Somerset Local Studies Library has kindly produced a transcript of an interview with a Mr Victor Foster who knew Hippisley well. Apparently Hippisley was on duty in 1912 at a wireless station on the Lizard (Poldhu presumably) when he heard the distress calls from the sinking Titanic! Later in Oct 1914, he began picking up coded Morse messages of 5 figure/letter groups. With other radio friends, including Russell Clarke THX of Abergavenny, they were mystified! To obtain more information they resorted to a longer aerial, consisting of an unused private telephone line (single wire with earth return) that he had from Ston Easton to the neighbouring village of Cameley where his cousin had been rector. Not being able to interpret these messages he eventually sent them to the Admiralty in London who were not able to do any better! Russia was also at war with Germany but nothing was being received via normal listening services from the Germans—just radio silence. On Oct 20th a German battleship was sunk in the Baltic by the Russians and a sailor was washed ashore clutching a codebook. Being unable to use it, the Russians sent it to London and this enabled Hippisley's indecipherable messages to be read as German Fleet orders. This persuaded Government to set up a purpose built listening station which they sited at Old Hunstanton on the Norfolk coast. This site and building is relatively well documented, although I could not find it recently when nearby! It was known as the Hippisley Hut and fed information from radio intercepts into the official intelligence organisation which came eventually to be known as Room 40. Charles Lambert G2ST was instrumental in setting up this organisation and recruited HJ Round from the Marconi Co to develop direction finding receivers. The Hut was initially run by Lambert who also wrote children's stories under the nom-de-plume AJ Alan! Lambert eventually became supreme head of MI6 in both Wars. Amongst many other successes, the Hut gave the Royal Navy a crucial 4 1/2 hours early warning prior to the Battle of Jutland by detecting a very small change in the bearing of the received German signals - indicating their fleet had left port.

When Hippisley departed to Norfolk, it is thought he may have taken a number of local radio enthusiasts with him since their previously well publicised activities in the West Country seem to suddenly cease! He had an extensive 'shack' in his cellar but little is definitely known about the actual radio equipment he was using. Foster noted very early 'servo' equipment in Hippisley's 'shack' for the transmission of shipboard angular information (e.g. relative wind direction) which was being maintained by Horstmanns of Bath - what we would now call Selsyns (resolvers/synchros) using 3 phase AC signals. When he left Ston Easton, the house was shut up and became neglected only to be refurbished many years later by the new owners, the family of William Rees-Mogg—later editor of the Times. It is reputed that local buoys found all the technical equipment when rummaging through the almost derelict house!

Dave Buddery thinks Hippisley may have formally set up a listening Hut in Somerset for the task of intercepting German radio traffic in the Western Approaches. I have not found any firm evidence for this. My opinion is that he performed these early intercepts using his own equipment installed at Ston Easton and that a dedicated 'western' Hut never existed. Information on the equipment being used by both sides of that war is patchy! In the early stages all would have been using rotary spark transmitters, probably with long wavelengths up to 2000m. A long wavelength increases the chance of a spark or kick in each RF cycle (of the simple damped tuning circuits defining the frequency of operation) so should improve the average RF output power. It is suggested that Hippisley's own spark transmitter would have been rated at around 500 Watts with shipborne sets of up to a kW or more. All the receivers would have been crystal sets using galena detectors at the start of the war, though later 3 stage valved sets with reaction were used by the services (certainly by the Germans), but most Navies are pretty conservative and spark transmitters, crystal detectors and low frequencies are likely to have been predominant till the end of the war.

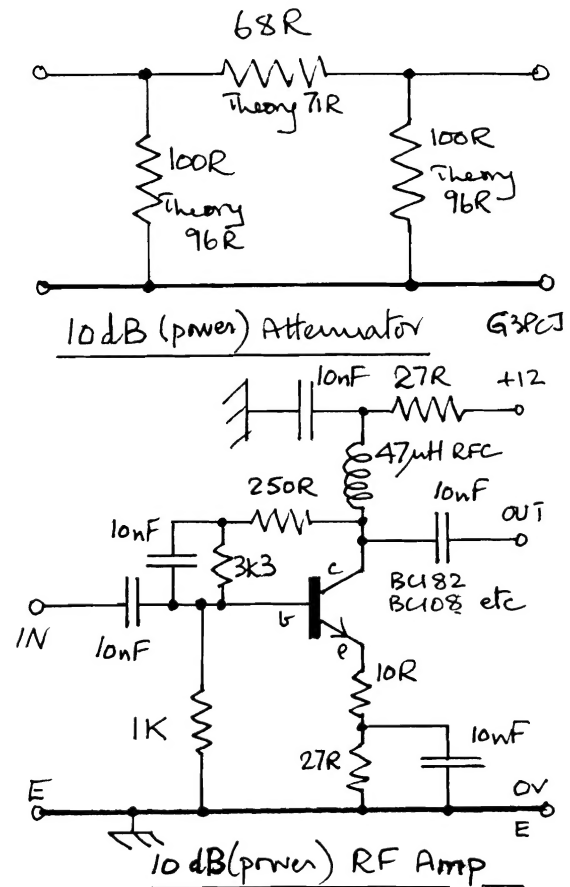
The sources for this note are too many to list sensibly, but many thanks to Dave Buddery for prompting the investigation—it was most interesting. As a footnote, I suggested to the 'historic radio' section of the Yeovil Club that we should put a replica spark transmitter on air (with all the filtering etc to make it legal) but my suggestion was not intercepted! (I know others have tried!) Tim Walford G3PCJ



## Useful Test Gear!

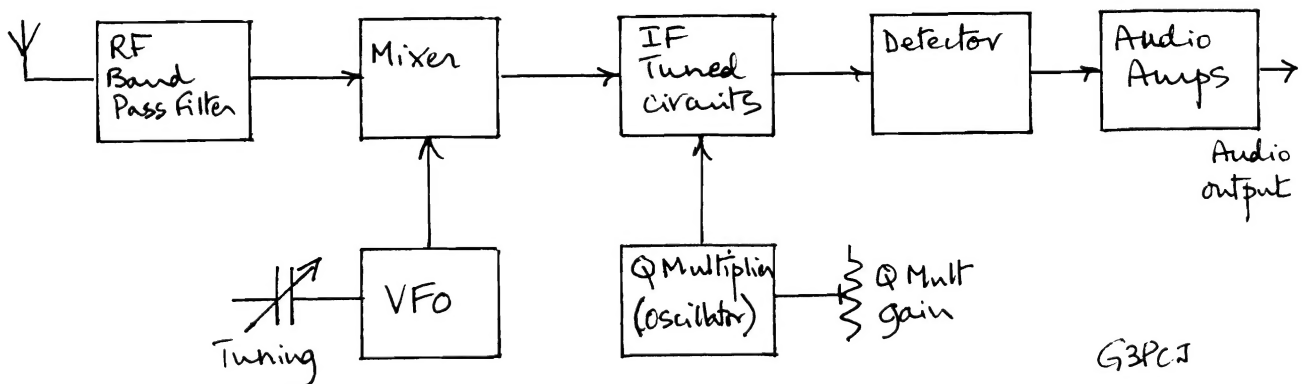
In RF work it is very common to find circuits using a 50R impedance for most signal lines. General purpose amplifiers and attenuators, with 50R in and out impedances, are most useful units to have available on your bench. They can easily be made broadband so can just be added, for example, ahead of a RX on a temporary basis to see if less signal will reduce BCI problems, or to add a bit of gain to compensate for a short receiving antenna.

Both circuits right are broadband and will cover 2 to 30 MHz. The attenuation is 10 dB power which implies a reduction in voltage by a factor of 3.3 when operating with matched source and load impedances. The gain of the amp is 10 dB (x10) for power or times 3.3 for voltage with matched 50R in and out. The supply is not critical but should be well filtered if amplifiers are cascaded. Maximum output will depend on the device standing current and should be around one tenth of a watt or +20 dBm for the values given. (Note. 0 dBm is one milliwatt into 50R, so +20 dBm is two lots of x10 power or times 100 compared to one milliwatt = 100 mW = one tenth of a watt.) Tim G3PCJ



## Q Multiplying Superhets!

The key point about a superhet is that the incoming frequency is changed to another where narrow filtering can be carried out rather more easily. Hence the early single conversion superhets changed the frequency down because the lower IF had a smaller bandwidth for a given Q in the tuned transformers that were used originally. An alternative to the modern technique of using a crystal filter for really narrow bandwidths is to use a regenerative stage, this can raise the Q of a tuned circuit to 1000+ easily! The snag is that it becomes rather tender and not really tuneable! The solution is a tunable local oscillator driving the mixer for the down conversion. Then the high Q stage can be fixed frequency and less temperamental. As ever, you need to make certain that the right mixer product is being received so good RF filtering is required; this prevents the unwanted image at twice the IF from the LO getting into the mixer. Either sum or difference mixing can be used but if the LO is above the wanted RF there is less chance of its harmonics getting into the front end and causing birdies. This technique was used as an adjunct to general coverage RXs in the valve era - known as a Q multiplier. An almost oscillating extra IF stage was coupled to the original IF amp and could markedly decrease the IF bandwidth of a previously wide open RX! G3PCJ



## **Assorted Snippets!**

**PCB Material for VFOs.** Charles Wilson forwards an article which points out that you need to wait several hours after building a VFO before measuring its frequency stability! This allows the parts to revert to ambient temperature and stabilise mechanically. It suggests that VFO stability may be improved by purposely ageing the board. Pack the PCB moist free in a plastic freezer bag and leave in the deep freeze compartment of your fridge for a couple of hours. Remove from fridge and allow bag with board inside to warm up to room temperature for an hour or so. Then put the bag on a hot central heating radiator for another couple of hours! Allow to cool down and return to the fridge. Repeat these extreme temperature cycles three times and with luck, the board will be free of mechanical stresses and give optimum stability! Its bad enough taking frequency readings for an hour after changing components for better temperature compensation, but this is seriously time consuming! It helps to emphasise that best VFO stability requires high quality parts with excellent mechanical rigidity. Charles doesn't like double sided PCBs for VFOs but I have not had problems.

**Fuse cap heatsinks.** Andy Howgate suggests that the end caps of (blown) mains fuses will fit snugly over TO92 shaped transistors; this allows you to solder on a loop of wire etc which can help to radiate the heat! Very useful for those rigs using BS170 MOSFETs in their output stage! A loop of wire is better than a small piece of sheet material since it will have less capacitance to whatever is nearby.

## **Reduced price kits!**

I have two Boosters which are surplus to requirements. I am open to offers bearing in mind their normal price of £49! On the TX side, they need about 1 W drive to produce 20W on a 13.8 volt supply. They also include RF sensing with two TR relays, and a receive 10 dB broadband amplifier. Input and output to the four IRF510 FETs is by two sizes of ferrite rings. Full of goodies!

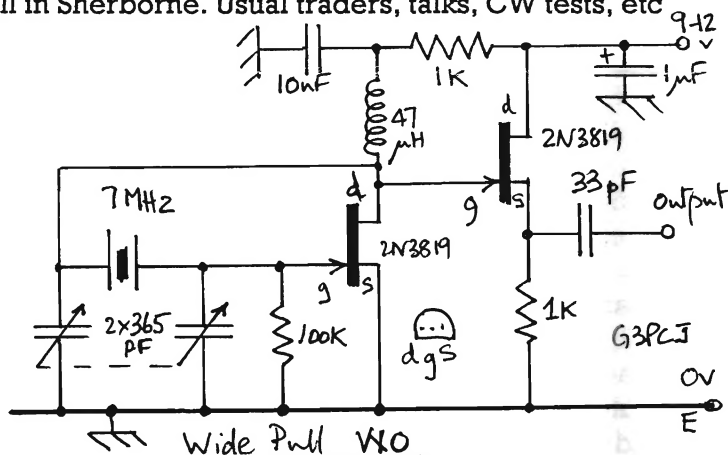
I am also expecting to receive a Bristol kit back from a customer who has decided it is too complex for him. I am assured it is untouched so should be complete. Let me know if interested.

## **New date for QRP Convention!**

I am advised that the date has had to be changed again to avoid a bad clash of local events. The new date is June 8th 2003 at the Digby Hall in Sherborne. Usual traders, talks, CW tests, etc

## **Simple Wide Range VXO**

The circuit right has a reasonable pulling range without the need for extra rather temperamental inductors! It does about 6 KHz swing at 7 MHz with only a total of 15 parts including the buffer! If you only have a single gang variable capacitor, then replace the other missing section with around 100 pF; the swing will not be quite so large but still quite useful for dodging QRM! It can be used over the entire HF range



I end this issue with a photograph of my Fivehead with 10 Watt Linear attached. It uses two IRF510 FETs in a push-pull arrangement. Jim Gearey's Fivehead looks much better than mine but I don't have a photo of it with his Linear—not that he really needs it! His first contact and barefoot, (on 20m) was with DL6OCF, who gave him 5 and 5 which was rather pleasing, especially when the other station was running a kilowatt! Having now installed a counterpoise to stop RF feedback, he has added Poland, Lithuania & Italy.

My apologies for the slight delay in getting this issue out. Happy Christmas and a good building year to you all, Tim G3PCJ

